GSFC Experiment DUT Board for MPTB

INTRODUCTION

The Microelectronics and Photonics Testbed (MPTB) is a DoD-sponsored effort being developed by the Naval Research Lab intended to sponsor testing of microelectronics and photonics in a harsh radiation environment. GSFC proposes to provide an experiment DUT board to measure Bit Error Rate (BER) of emerging fiber optic data bus transceivers as well as to measure single event upset (SEU) response of devices previously flown on CRRES.

PRELIMINARY DESCRIPTION - fiber optic experiment

NASA/GSFC, jointly with the Naval Research Laboratory (NRL), has been a leader in the development and/or implementation of fiber optic data busses in spacecraft systems. The success of the MIL-STD-1773 fiber optic data bus (or 1773 bus) on the Solar Anomalous Magnetospheric Particle Explorer (SAMPEX) spacecraft, launched in July of 1992, has paved the way towards the acceptance of fiber optics in the space environment.

An extensive radiation ground test program was undertaken on the 1773 bus components prior to flight. This collaborative NASA/NRL effort led to the formation of SEU models for fiber optic components as well as accurate predictions of SAMPEX in-flight performance. Further ground testing on other fiber optic components have extended these technology and design-specific SEU models.

The 1773 bus, however, has its limitations. They include:

- Albeit the 1773 bus has a maximum signalling rate of 1 Mbps, its actual effective data rate is limited to around 400 kbps. Thus, the 1773 bus is useful for low-speed applications such as the collection of housekeeping telemetry on most spacecraft. And,
- The implementation of the 1773 bus on SAMPEX relies on SEU-sensitive receiver design (both optically and electrically). Fortunately, a combination of relatively low bus utilization (thus, allowing for retransmission of unsuccessful messages) and protocol level error handling exists and allows for a robust system. However, at higher data rates and/or higher bus utilization rates, the system does not have the luxury of retransmitting every message in error.

There is a potential solution: MIL-STD-1773A is a dual-rate (1 and 20 Mbps) fiber optic data bus that is emerging in many military, commercial, and aerospace programs. The 20 Mbps data transfer rate covers the requirements of >80% of spacecraft instruments. Additionally, two separate transceiver designs exist (Boeing and Univ. of New Mexico NASA Space Engineering Research Center), both of whose designs are hardened to SEUs.

NASA/GSFC code 735.1, under NASA HQ/QW Research funding for emerging

technologies as well as potential funding from DNA, is preparing to perform SEU ground tests on both transceiver designs before the end of the calendar year.

We propose to develop an experiment for the MPTB program that will perform in-flight BER measurements on both of the MIL-STD-1773A transceivers as well as the current 1773 bus components. This experiment provides validation of the fiber optic SEU models that have been developed as well to provide further verification of the usability of fiber optic systems in spaceflight applications.

PRELIMINARY DESCRIPTION - CRRES devices

Numerous spacecraft experience unexplained performance anomalies and failures. It is suspected that many of these are due to the radiation environment. In order to address this problem, it is desirable to obtain reliable information from a controlled experiment about the impact of the environment on known parts. For this purpose, it is proposed to include the following part types on the NASA MPTB daughter board: HS1-6504RH and AM-93L422. The use of these parts is considered advantageous because extensive ground test data for TID and SEE is available, and because these parts have in the past flown, and in some cases, are still flying on several satellites (HST, TDRS, CRRES, etc...). Thus, a controlled experiment with these devices provides a unique opportunity to correlate the special data to be received from MPTB with past and current spacecraft performance histories.